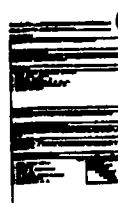
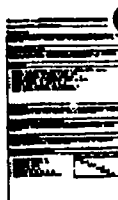
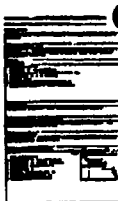
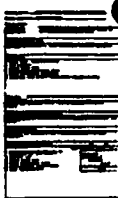
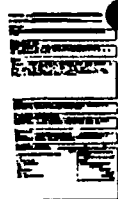
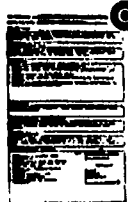


AD A109380

DTIC FILE COPY



LA 11

2

TRW-34320-6004-UT-00

LONG RANGE PLAN FOR EMBEDDED COMPUTER SYSTEMS SUPPORT

VOLUME I EXECUTIVE OVERVIEW

12 26

1981 October

APPROVED FOR PUBLIC RELEASE
DISTRIBUTION UNLIMITED

DTIC
SELECTED
JAN 7 1982
A

CDRL 05A
Contract Number F33600-79-C-0540

Prepared for
Air Force Logistics Command AFLC/LO
Wright Patterson AFB, Ohio 45433

UNCLASSIFIED/UNLIMITED

TRW
DEFENSE AND SPACE SYSTEMS GROUP
ONE SPACE PARK • REDONDO BEACH • CALIFORNIA 90278

409637

82 01 07 035

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD A109380	
4. TITLE (and Subtitle) LONG RANGE PLAN for EMBEDDED COMPUTER SYSTEMS SUPPORT VOLUME I-Executive Overview		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) F33600-79-C-0540 CDRL 05 A
9. PERFORMING ORGANIZATION NAME AND ADDRESS TRW/DEFENSE and SPACE GROUP ONE SPACE PARK REDONDO BEACH, CA 90278		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS HQ AFLC/LOEE WRIGHT-PATTERSON AFB, OH 45433		12. REPORT DATE October 1981
		13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release, Distribution Unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Recommendations pertaining to administrative and programmatic initiatives are presented in this VOLUME. Companion documents dated October 1981, September 1980, same contract number.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Planning ECS Computer Systems Management Technological Forecasts Avionics Logistic Support Program Management Logistic Management Weapon System		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The life cycle support of the ever increasing number of computer systems embedded in weapon systems is a major challenge to the Air Force. With continued operational and support emphasis on performance and responsiveness to a dynamic mission environment, significant enhancement of support capabilities for all categories of embedded computer systems is required. This report contains recommendations for acquiring such capabilities. <i>Page 16</i> VOLUME I of 2.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

RESPONSIBILITY. The controlling DoD office will be responsible for completion of the Report Documentation Page, DD Form 1473, in all technical reports prepared by or for DoD organizations.

CLASSIFICATION. Since this Report Documentation Page, DD Form 1473, is used in preparing announcements, bibliographies, and data banks, it should be unclassified if possible. If a classification is required, identify the classified items on the page by the appropriate symbol.

COMPLETION GUIDE

General. Make Blocks 1, 4, 5, 6, 7, 11, 13, 15, and 16 agree with the corresponding information on the report cover. Leave Blocks 2 and 3 blank.

Block 1. Report Number. Enter the unique alphanumeric report number shown on the cover.

Block 2. Government Accession No. Leave Blank. This space is for use by the Defense Documentation Center.

Block 3. Recipient's Catalog Number. Leave blank. This space is for the use of the report recipient to assist in future retrieval of the document.

Block 4. Title and Subtitle. Enter the title in all capital letters exactly as it appears on the publication. Titles should be unclassified whenever possible. Write out the English equivalent for Greek letters and mathematical symbols in the title (see "Abstracting Scientific and Technical Reports of Defense-sponsored RDT&E," AD-667 000). If the report has a subtitle, this subtitle should follow the main title, be separated by a comma or semicolon if appropriate, and be initially capitalized. If a publication has a title in a foreign language, translate the title into English and follow the English translation with the title in the original language. Make every effort to simplify the title before publication.

Block 5. Type of Report and Period Covered. Indicate here whether report is interim, final, etc., and, if applicable, inclusive dates of period covered, such as the life of a contract covered in a final contractor report.

Block 6. Performing Organization Report Number. Only numbers other than the official report number shown in Block 1, such as series numbers for in-house reports or a contractor/grantee number assigned by him, will be placed in this space. If no such numbers are used, leave this space blank.

Block 7. Author(s). Include corresponding information from the report cover. Give the name(s) of the author(s) in conventional order (for example, John R. Doe or, if author prefers, J. Robert Doe). In addition, list the affiliation of an author if it differs from that of the performing organization.

Block 8. Contract or Grant Number(s). For a contractor or grantee report, enter the complete contract or grant number(s) under which the work reported was accomplished. Leave blank in in-house reports.

Block 9. Performing Organization Name and Address. For in-house reports enter the name and address, including office symbol, of the performing activity. For contractor or grantee reports enter the name and address of the contractor or grantee who prepared the report and identify the appropriate corporate division, school, laboratory, etc., of the author. List city, state, and ZIP Code.

Block 10. Program Element, Project, Task Area, and Work Unit Numbers. Enter here the number code from the applicable Department of Defense form, such as the DD Form 1498, "Research and Technology Work Unit Summary" or the DD Form 1634, "Research and Development Planning Summary," which identifies the program element, project, task area, and work unit or equivalent under which the work was authorized.

Block 11. Controlling Office Name and Address. Enter the full, official name and address, including office symbol, of the controlling office. (Equates to funding/sponsoring agency. For definition see DoD Directive 5200.20, "Distribution Statements on Technical Documents.")

Block 12. Report Date. Enter here the day, month, and year or month and year as shown on the cover.

Block 13. Number of Pages. Enter the total number of pages.

Block 14. Monitoring Agency Name and Address (if different from Controlling Office). For use when the controlling or funding office does not directly administer a project, contract, or grant, but delegates the administrative responsibility to another organization.

Blocks 15 & 15a. Security Classification of the Report; Declassification/Downgrading Schedule of the Report. Enter in 15 the highest classification of the report. If appropriate, enter in 15a the declassification, downgrading schedule of the report, using the abbreviations for declassification/downgrading schedules listed in paragraph 4-207 of DoD 5200.1-R.

Block 16. Distribution Statement of the Report. Insert here the applicable distribution statement of the report from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 17. Distribution Statement (of the abstract entered in Block 20, if different from the distribution statement of the report). Insert here the applicable distribution statement of the abstract from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 18. Supplementary Notes. Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of (or by) . . . Presented at conference of . . . To be published in . . .

Block 19. Key Words. Select terms or short phrases that identify the principal subjects covered in the report, and are sufficiently specific and precise to be used as index entries for cataloging, conforming to standard terminology. The DoD "Thesaurus of Engineering and Scientific Terms" (TEST), AD-672 000, can be helpful.

Block 20. Abstract. The abstract should be a brief (not to exceed 200 words) factual summary of the most significant information contained in the report. If possible, the abstract of a classified report should be unclassified and the abstract to an unclassified report should consist of publicly-releasable information. If the report contains a significant bibliography or literature survey, mention it here. For information on preparing abstracts see "Abstracting Scientific and Technical Reports of Defense-Sponsored RDT&E," AD-667 000.

34330-6004-UT-00

LONG RANGE PLAN FOR EMBEDDED COMPUTER SYSTEMS SUPPORT

VOLUME I EXECUTIVE OVERVIEW

1981 October

CDRL 05A
Contract Number F33600-79-C-0540

Prepared for
Air Force Logistics Command AFLC/LO
Wright Patterson AFB, Ohio 45433

This document has been approved
for public release and sale; its
distribution is unlimited.

TRW
DEFENSE AND SPACE SYSTEMS GROUP
ONE SPACE PARK • REDONDO BEACH • CALIFORNIA 90278

FOREWORD

The life cycle support of the ever increasing number of computer systems embedded in weapon systems is a major challenge to the Air Force Logistics Command. With continued operational and support emphasis on weapon system performance and responsiveness to a dynamic mission environment, significant enhancement of support capabilities for all categories of embedded computer systems is required. This report, Executive Overview (Volume I), and Long Range Plan for Embedded Computer Systems Support (Volume II) contain recommendations for acquiring such capabilities.

This volume is one of two individually bound volumes that constitute the Phase III Final Report, Study of Embedded Computer Systems Support, for Contract F33600-79-C-0540, CDRL 05A. The efforts and analyses reported in these volumes were sponsored by AFLC/LO and cover a reporting period from December 1980 through August 1981.

Approved For	
Classified	<input checked="" type="checkbox"/>
Unclassified	<input type="checkbox"/>
Justification	<input type="checkbox"/>
Re	
Distribution/	
Availability Codes	
Avail and/or	
Dist Special	
A	

CONTENTS

FOREWORD	ii
1. INTRODUCTION AND BACKGROUND	1
2. LONG RANGE PLAN	5
2.1 Development Approach	5
2.2 Benefits Associated with ECS Support Initiatives	11
3. IMPLEMENTATION APPROACH	14
4. SUMMARY	16

TABLES

1.	ECS Support Concepts by Category	4
2.	Administrative Initiatives and Recommendations	10
3.	Programmatic Initiatives and Recommendations	11
4.	Programmatic Initiatives: Summary	18

ILLUSTRATIONS

1.	Ten-Year Forecast: DOD Embedded Computers	1
2.	Ten-Year Forecast: Hardware/Software Costs	1
3.	Software Support Analogous to Development	2
4.	Phase II Final Report	3
5.	Phase III Final Report	4
6.	Long Range Plan for Support of ECS: Development Approach	5
7.	Long Range Plan for Support of ECS: Implementation Approach	15
8.	Initiatives for Improving ECS Support Posture	17

1. INTRODUCTION AND BACKGROUND

Support of Embedded Computer Systems (ECS) in the 1980's presents a major challenge to the Air Force Logistics Command (AFLC). The incorporation of digital technology in weapon systems has introduced a new dimension to the acquisition, operational, and support environments. Although technological advances have occurred in virtually all aspects of weapon system functions, they are particularly evident in weapon systems that encompass embedded computer systems as an integral part of the system structure. This trend is expected to continue along with

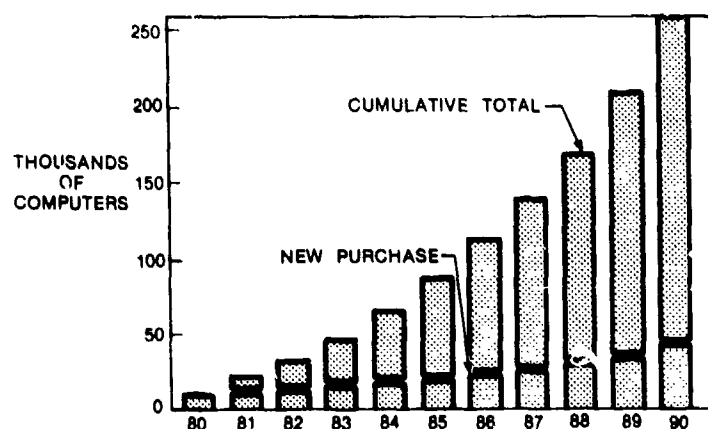


Figure 1. Ten-Year Forecast: DOD Embedded Computers

major shift in support philosophy that also occurred in the early 1970's. This shift towards increased government support and the corresponding increase in government control was designed to improve mission responsiveness. The magnitude of the future ECS support

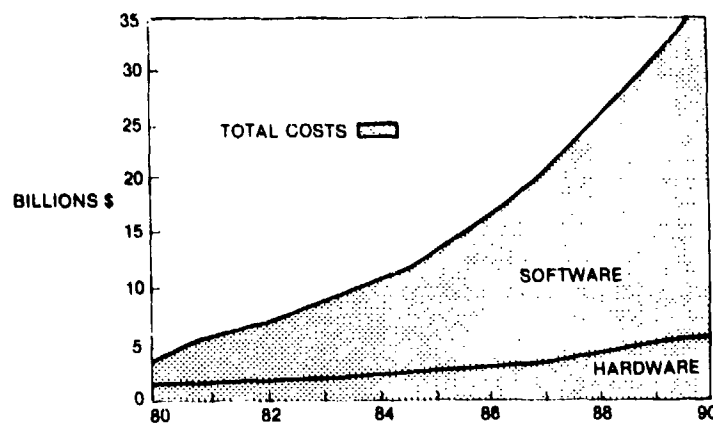
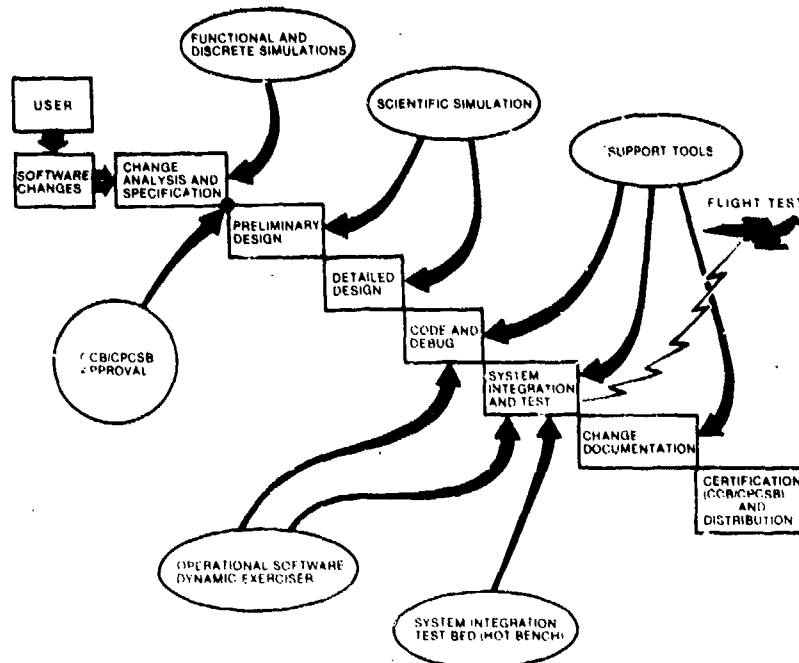


Figure 2. Ten-Year Forecast: Hardware/Software Costs

increases in application to avionics functions, due to dramatic increases in computing capability coupled with decreases in size and weight. Several systems have been deployed, and problems associated with their support, particularly the support of computer programs, surfaced in the early 1970's. Many of these problems can be attributed to past acquisition practices and user expectations, as well as a

workload in terms of numbers of computers (Figure 1) and hardware and software costs (Figure 2) is indicated by a recent Electronics Industry Association DOD Digital Data Processing Study. The study was performed by an industry team consisting of representatives from Control Data Corporation, IBM, INTEL, ROLM Corporation, and TRW.

The requirement to provide ECS support stems from the traditional logistics weapon systems support role of buying, supplying, transporting, and maintaining systems. However, the management and technical support of ECS, and particularly the change process for ECS software, is an engineering-intensive activity. Modification of computer programs to meet specifications or new performance requirements is dependent on engineering and scientific disciplines, as well as sophisticated equipment and tools. The change process for operational flight software, which is normally accomplished within a period of 12 to 18 months between fielded versions, is very similar in process and procedure to the original development effort (Figure 3). In some



cases, it may be even more demanding due to support of multiple versions for a single weapon system, or new requirements demands imposed upon an embedded computer system operating at full capacity, thereby necessitating major redesign of the existing operational software.

Considerable progress has been made in the support of ECS, and several complementary efforts, in-

Figure 3. Software Support Analogous to Development

cluding this contractor study of ECS support, have been initiated by AFLC. The purpose of this study, which was the first comprehensive look at ECS support since the Pacer Flash effort in the early 1970's, was to develop a long range plan to be used by AFLC to manage and support ECS on a command-wide basis in the 1980's while developing a cost-effective support posture for the 1990's. This three-phase study effort was initiated in September 1979 and included the following specific tasks:

◆ Phases I and II

- Develop a program plan which describes the study approach, procedures, and schedules.
- Establish a baseline for ECS support functions and requirements; assess current ECS support posture for the five ECS categories.

- Assess and forecast major technology impacts on future systems and their attendant support requirements.
- Investigate the potential use of networking and the National Software Works (NSW), and other support concepts.

Phase III

- Develop a long range plan for improving the AFLC embedded computer system support posture for the 1980's.

The Phase II report, completed in September 1980, included a classified volume on ECS readiness support and the nine separate volumes shown in Figure 4.

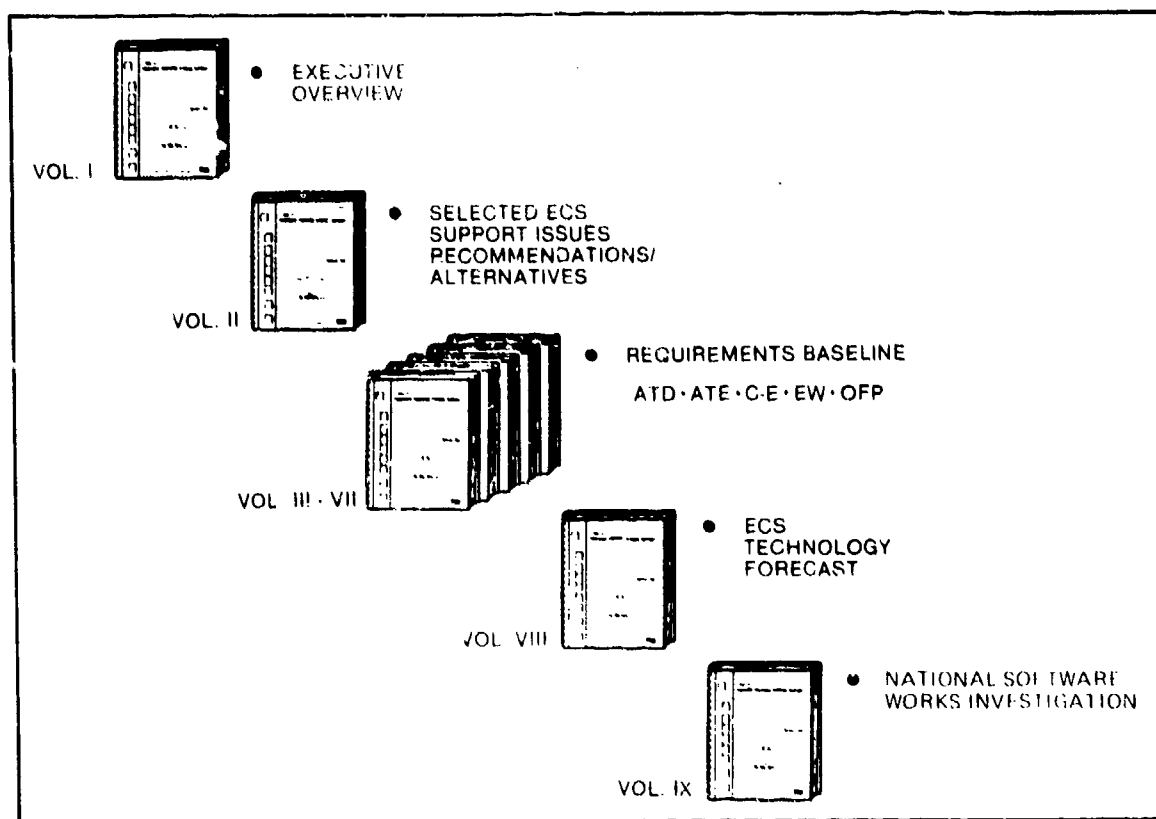


Figure 4. Phase II Final Report

The long range plan, developed during Phase III of the study, is based on projections of the future ECS support environment, anticipated ECS support workload, and postulated objectives or intentions with regard to support of ECS in the future (Figure 5). The plan encompasses the five categories of ECS identified in AFLCR 800-21 and uses the support concepts described therein as a starting point (Table 1). The plan also draws upon the current posture assessments

Table 1. ECS Support Concepts by Category

COMPUTER RESOURCES INCORPORATED AS INTEGRAL PARTS OF, DEDICATED TO, REQUIRED FOR DIRECT SUPPORT OF, OR FOR THE UPGRADING OR MODIFICATION OF, MAJOR OR LESS THAN MAJOR SYSTEM(S) DODD 5000.29.

◆ CATEGORY	◆ CONCEPT
ATD AIRCREW TRAINING DEVICES	DEVELOPMENT ENGINEERING PROTOTYPE SITES (DEPS)
ATE AUTOMATIC TEST EQUIPMENT	SOFTWARE SUPPORT CENTERS (SSC'S)
C-E COMMUNICATIONS-ELECTRONICS	C-E INTEGRATION SUPPORT FACILITY (C-E ISF)
EW ELECTRONIC WARFARE	EW AVIONICS INTEGRATION SUPPORT FACILITY (EWAISF)
OFF OPERATIONAL FLIGHT PROGRAMS	AVIONICS INTEGRATION SUPPORT FACILITY (AISF)

and associated deficiencies identified in the nine-volume final report, resulting from the precursor Phase II Study of Embedded Computer Systems Support. The plan outlines the HQ AFLC management and technical activities required to establish a command-wide ECS support posture, and provides methodology including resource estimates and schedules for implementing the plan. The

following sections describe the factors affecting development of the recommended initiatives, the initiatives and associated benefits, and the approach for implementing the initiatives.

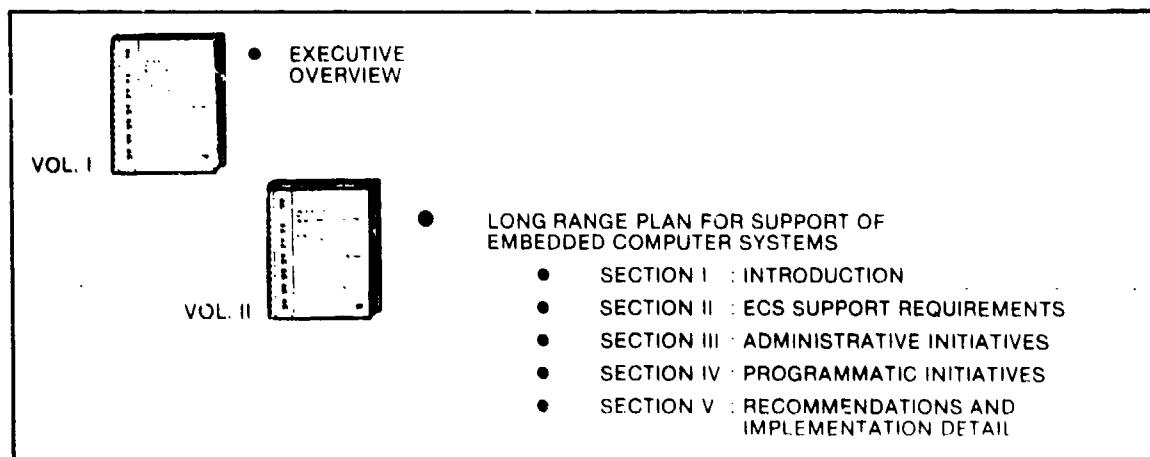


Figure 5. Phase III Final Report

2. LONG RANGE PLAN

The focus of the long range ECS support plan is on reducing aggregate ECS support costs by increasing productivity and mission-responsive support for the five ECS categories; by aggressively clarifying policy and guidance; and by concurrently enhancing current capabilities and acquiring new capabilities. Key features of the plan are a building block approach to take advantage of previous investments in ECS support resources and recommended initiatives in the following areas for correction of current deficiencies and progressive modernization of ECS support resources.

- Administrative initiatives in the areas of management, engineering, acquisition, and support practices to establish uniform policies and guidance in the near term
- Programmatic initiatives in the areas of support tools, modularity, readiness, and communications to automate, standardize, and modernize the ECS support process in the mid and long term

2.1 DEVELOPMENT APPROACH

The long range plan addresses the life cycle of ECS support, as well as improving the current support posture to meet an anticipated future workload. An important first step in the development was to establish a framework that would encompass the acquisition and operation of ECS support systems, correct current deficiencies, satisfy all known or projected ECS support requirements, and at the same time provide an overall context for development of the long

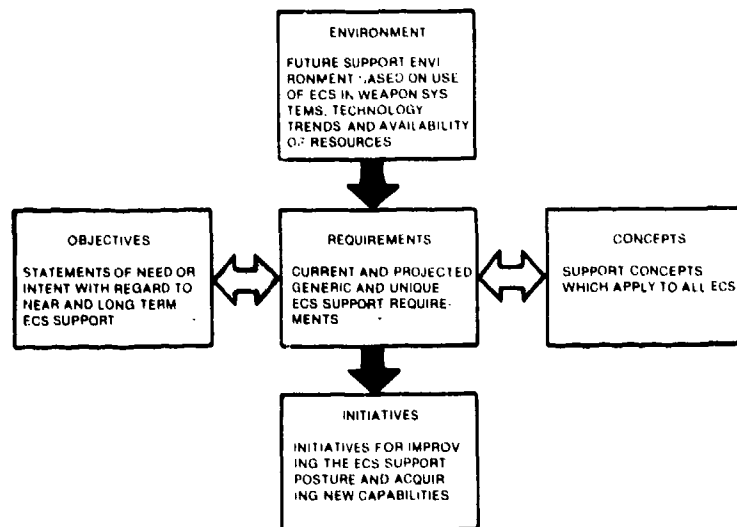
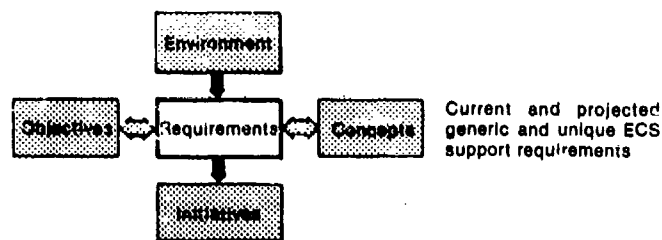


Figure 6. Long Range Plan for Support of ECS: Development Approach

range plan. Such items as the future ECS support environment, the AFLC objectives and intentions, and the overall support concepts to be employed, were established to provide these parameters, which are discussed in the following paragraphs. Their relationship to the requirements established in Phase II and the initiatives developed in Phase III, are shown in Figure 6.



The support of embedded computer systems, consisting of computer equipment and computer programs, is based upon the experience that over a period of time, changes/modifications

will be necessary to correct deficiencies, enhance system capabilities in response to operational need, and adapt the weapon system to a new role or mission during the period of its life cycle. Experience also shows that system deficiencies and modifications are frequently more readily correctable by altering the software than the hardware.

Support requirements are driven by the nature of the embedded computer system's functional role in the weapon system. For example, if the OFP is resident in an Inertial Measurement Unit (IMU) and navigation is the only ECS function, the support requirement will be of different magnitude than if the OFP is the integrator and controller for a weapon system that delivers nuclear weapons. In either case, however, the task of changing or modifying the ECS can be partitioned into a definable set of requirements. These requirements are often thought of as activities, or expressed as a sequential process. The following life cycle ECS support requirements are divided into ECS generic and unique requirements.



Generic Requirements

- Life Cycle

Management

System Engineering

Training

- Pre-PMRT ECS Support

Support System Requirements

Supportability Design
Criteria

- Post-PMRT ECS Support

ECS Change

Change Analysis and
Specification

Engineering Development
and Unit Test

System Integration and Test

Change Documentation

Certification and Distribution



Unique Requirements

- Post-PMRT ECS Support

Concurrency with Weapon
System (ATD)

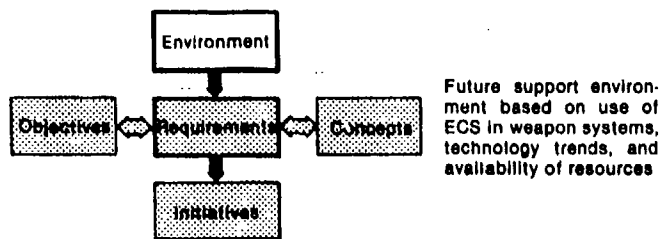
Interagency Shared Software
Support (C-E)

Intelligence Data Usage
(C-E, EW, OFP)

Rapid Reprogramming
Capability (C-E, EW, OFP)

High Frequency Change
(C-E, EW, OFP)

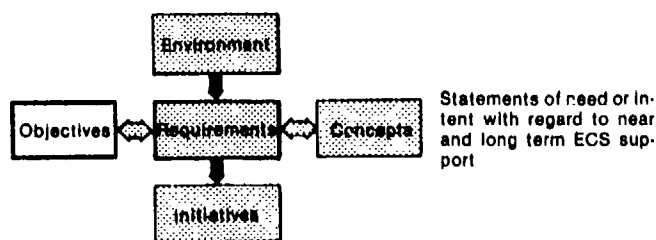
Nuclear Safety Criteria
(OFP)



An accurate prognostication of the future is impossible, but a consensus of recent government and industry studies and analysis indicates that a realistic projection of the future ECS support

environment will include continuation of a rapidly evolving and expanding use of technology, an ever-increasing enemy threat and corresponding demand for mission responsiveness, and continuing competition for scarce ECS support resources. In short, within the DOD and Air Force, the pressure for "better-faster-more with less" is expected to continue. Consequently, the foreseeable and postulated future ECS support environment is expected to be characterized as follows:

- Continued world tension with alignment/realignment of national interests
- Multi-service and multi-nation use of ECS and ECS support systems
- Increasingly complex weapon and support systems
- Rapidly evolving and expanding use of technology in weapon and support systems
- Increased pressure for interoperability and standardization of ECS and ECS support systems
- Increased vulnerability of ECS to enemy countermeasures
- Extension of ECS support systems to theater and flight line for combat mission needs
- Increased competition for engineering and scientific disciplines as well as support funds
- Rapidly increasing ECS workload
- Increased need for ECS management and technical training

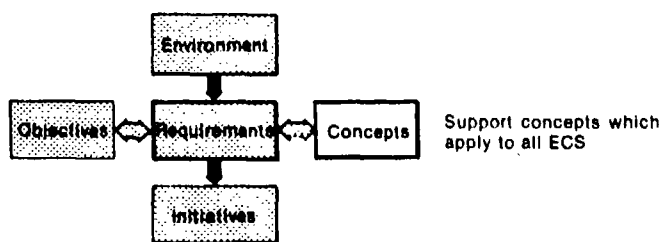


The current HQ AFLC 80-1 Statement of Need (SON)/Mission Element Need Analysis (MENA) addresses the practice of acquiring system specific or point design ECS support facilities

(tools, equipment, and skills) and the need for increased standardization and automation of ECS support processes and procedures, along with increased integration and sharing of critical ECS support resources. This long range ECS support plan, which supports the SON/MENA, is

based upon a set of 12 postulated ECS support objectives. These objectives, which are closely related, were compiled from a longer list of more specific problem/deficiency objectives and are therefore not necessarily aimed at any one ECS support requirement or current/projected deficiency. They are applicable to the entire life cycle ECS acquisition and support process and extend across the five ECS categories.[†]

- Acquire and maintain a flexible technical support base and establish data flow to rapidly respond to ECS combat needs.
- Provide efficient and effective ECS life cycle management and system engineering support.
- Promote efficient, effective, and timely use of interservice as well as inter- and intracommand ECS support resources.
- Acquire and maintain quality ECS and ECS support systems.
- Ensure currency and survivability of ECS support systems.
- Acquire and maintain ECS technology and intelligence bases, and provide for intercommand and interservice exchange and use of data.
- Ensure an attractive and competitive ECS management and engineering career field.
- Minimize critical organic ECS engineering, scientific, and technical skill needs.
- Provide for efficient and effective training and cross-training in ECS engineering, scientific, and technical skills.
- Optimize the complementary strengths of organic and contractor skills.
- Accomplish efficient and effective ECS support cost estimating, tracking, and accounting.
- Influence the proliferation of ECS and ECS support systems.



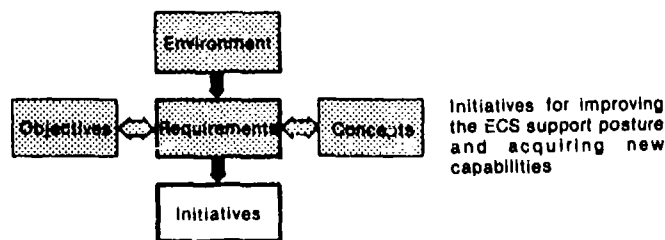
Support concepts for each of the five ECS categories as currently documented in AFLCR 800-21 have evolved over a period of time. While these individual category concepts are

still in various stages of implementation, the technology implemented in future weapon system designs is expected to blur the currently perceived distinction between the five categories, particularly between C-E, EW, and OFP. Closely coupled with the individual category support

[†] Volume II, Appendix A, contains an elaboration of each of the objectives.

concepts, whatever their distinction or numbers, are ECS support concepts which are intended to apply within each category as well as across the categories. The following concepts address ECS support in the aggregate, and provide the framework for achieving the previously stated objectives and acquiring the overall ECS support capabilities required over the next decade.

- Increase ECS supportability and minimize ECS life cycle support costs by use of improved system engineering tools and techniques for ECS design-performance-support tradeoffs and ECS support planning.
- Minimize critical ECS engineering and scientific skill needs by optimization of organic/contractor skill mix, and increase the use of organic lower skilled ECS personnel by automation and standardization of ECS support processes and procedures.
- Maximize sharing of distributed ECS support resources by use of modular integrated ECS support facilities and standardized automated ECS support tools.
- Manage and support highly integrated ECS dispersed at geographically separated support locations by establishing a system for ECS management and technical data flow.
- Minimize dedicated ECS technology and intelligence resources by centralizing expertise and sharing intercommand and other service resources.
- Maximize ECS management and technical data flow by use of ECS support networks.



The recommended initiatives developed during Phase III, which apply to all ECS support, are closely related and in some cases, mutually dependent. The initiatives are divided

into two groups. The first group, the administrative initiatives, are those which are efficiency related and lend themselves to implementation with little initial impact on or within existing resources. Some of these initiatives will most likely evolve to program status depending upon policy decisions. However, the administrative initiatives are a collection of diverse interrelated activities with high potential for both near-term and long-term benefits, as well as establishment of context and direction for other longer term initiatives.

The administrative initiatives encompass management, engineering, acquisition, and support practices. These issues were selected through a filtering process which identified those issues having the greatest impact and the greatest promise of resolution. Although there are obvious interrelationships and interdependencies between administrative and programmatic initiatives, the distinction is made because policy and guidance initiatives are clearly in the Government's domain. The phase II report contains detailed discussions and recommendations in the areas of

personnel and training, funding, configuration management, microprocessor and firmware and product and data quality at transition. The additional recommended administrative initiatives and recommendations developed in Phase III are shown in Table 2. The combined Phase II and III recommendations are contained in Volume II of the long range plan.

Table 2. Administrative Initiatives and Recommendations

INITIATIVES	RECOMMENDATIONS
MANAGEMENT AND ENGINEERING PRACTICES <ul style="list-style-type: none"> ● MATRIX ORGANIZATION ● ECS CAREER PROGRESSION ● TRAINING AND PROFESSIONAL EDUCATION 	<p>STRONGLY CONSIDER CONSOLIDATION OF ECS HARDWARE AND SOFTWARE ENGINEERS AND APPLY THESE RESOURCES THROUGH MATRIXING AND ESTABLISHMENT OF SKILL CONCENTRATIONS</p> <p>DEVELOP DEFINITIVE CAREER INCENTIVES AND PROGRESSION PATHS TO ATTRACT AND RETAIN ECS PERSONNEL</p> <p>ESTABLISH A STRUCTURED PROGRAM WHICH CYCLES HARDWARE AND SOFTWARE ENGINEERS THROUGH FORMAL EDUCATIONAL COURSES AND CONTROLLED JOB TRAINING PROGRAMS</p>
ACQUISITION AND SUPPORT PRACTICES <ul style="list-style-type: none"> ● COMMON ECS SUPPORT COMPONENTS ● AUTOMATIC TEST EQUIPMENT ● MULTI-ECS WEAPON SYSTEM SUPPORT 	<p>QUANTITATIVELY INVESTIGATE USE OF STANDARDIZED MULTI-USE SIMULATIONS IN INTEGRATION SUPPORT FACILITIES AND AIRCREW TRAINING DEVICES</p> <p>IN COORDINATION WITH AIR FORCE SYSTEMS COMMAND AND USERS, DEVELOP SUPPORTABILITY STANDARDS FOR IMPLEMENTING TESTABILITY IN DESIGN PHASE AND FOR ACQUIRING DOCUMENTATION</p> <p>INVESTIGATE FEASIBILITY OF MULTI-ECS SUPPORT THROUGH USE OF STANDARD INTERFACES AND LOCAL AND COMMAND-WIDE ECS SUPPORT NETWORKS</p>

The second group, programmatic initiatives, are those which are related to productivity and mission responsiveness in accomplishing the ECS support process. Although they depend upon policy and direction for implementation, they are primarily longer term and require concentrated programs with considerable resources to build upon or augment existing capability, as well as acquire new capabilities. The four programmatic initiatives and recommendations shown in Table 3 are discussed in detail in Volume II, Section 4.

Table 3. Programmatic Initiatives and Recommendations

INITIATIVES	RECOMMENDATIONS
<ul style="list-style-type: none"> ● AUTOMATION AND STANDARDIZATION OF ECS SUPPORT PROCESSES 	ESTABLISH AND ARTICULATE POLICY AND GUIDANCE FOR CONDUCTING ECS SUPPORT PROCESS AND ACQUIRE AUTOMATED AND STANDARDIZED TOOLS FOR ACCOMPLISHING THE PROCESS
<ul style="list-style-type: none"> ● MODULAR EXTENDABLE INTEGRATION SUPPORT FACILITIES 	ESTABLISH STANDARD MODULES, INTERFACES, INTERFACE UNITS AND ARCHITECTURES, AND EXPAND AND EXTEND INTEGRATION SUPPORT CAPABILITIES TO MULTIPLE SYSTEMS AND MULTIPLE FUNCTIONS
<ul style="list-style-type: none"> ● ECS READINESS SUPPORT 	ESTABLISH INTELLIGENCE AND DATA HANDLING CAPABILITIES AND ENHANCE OR ESTABLISH SUPPORT CAPABILITIES FOR PREEMPTIVE ENGINEERING TO RESPOND TO ELECTRONIC THREATS
<ul style="list-style-type: none"> ● ECS SUPPORT NETWORKS 	ESTABLISH COMMUNICATIONS LINKS WITH CAPABILITIES FOR VOICE, DATA AND VIDEO TRANSMISSIONS TO SUPPORT LOCAL AND MULTIPLE SYSTEM INTEGRATION SUPPORT FACILITIES, AND TO SUPPORT COMMAND-WIDE MANAGEMENT AND ENGINEERING

2.2 BENEFITS ASSOCIATED WITH ECS SUPPORT INITIATIVES

Current AFLC management and engineering structure has evolved over the past several years. It was shaped to provide support to systems and items with primary emphasis on the hardware involved and was further designed to achieve spare and repair support without extensive regard to engineering development. The current and projected ECS support role, however, is engineering intensive and requires a broad range of initiatives to achieve a mission responsive future ECS support posture.

Implementation of the administrative initiatives directly affects the efficiency of the ECS support process in the near term as well as establishes the policy and guidance framework for implementation of the longer term programmatic initiatives. The ECS support posture or situation addressed by the initiatives is summarized in the following four broad current posture statements:

- ECS support processes are person-power intensive and in the aggregate use a proliferation of non-standard support tools procedures and nomenclatures which are costly and decrease efficiency and productivity.
- ECS support facilities are system unique with a proliferation of hardware and software for accomplishing common functions which increases costs and reduces productivity.
- Capability is limited, or non-existent, for responding to adversary threats to C-E, EW, and OFP (fire control radars) which affects mission responsiveness.

- Modern communications links do not exist for supporting management and engineering, increasing productivity and mission responsiveness, and offsetting training and travel costs.

Significant AFLC benefits for each area, resulting from implementation of the combined complementary initiatives, are summarized and keyed to the current posture statement and the programmatic initiatives.

ECS support processes are person-power intensive and in the aggregate use a proliferation of non-standard support tools, procedures, and nomenclatures which are costly and decrease efficiency and productivity.

INITIATIVE
AUTOMATION AND
STANDARDIZATION
OF ECS SUPPORT
PROCESSES

◆ **FUTURE ECS SUPPORT POSTURE BENEFITS**

Automated standardized ECS support tools and procedures for

- Management,
- Documentation,
- Analysis,
- Specification,
- Software development,
- Testing, and
- Local development projects.

ECS support facilities are system unique with a proliferation of hardware and software for accomplishing common functions, which increases costs and reduces productivity.

INITIATIVE
MODULAR EXTEND-
ABLE INTEGRATION
SUPPORT FACILITIES

◆ **FUTURE ECS SUPPORT POSTURE BENEFITS**

Builds upon existing investment in ECS support facilities to support

- Combat mission readiness;
- Weapon system growth and planned product improvements;
- Multiple systems with dissimilar architectures, languages, and input/output requirements with single ISF systems;

- Multiple functions with common modules;
- Automated standardized tools; and
- Training.

Capability is limited, or non-existent, for responding to adversary threats to C-E, EW, and OFP (fire control radars) which affects mission responsiveness.

INITIATIVE
ECS READINESS
SUPPORT

◆ **FUTURE ECS SUPPORT POSTURE BENEFITS**

ECS readiness support capabilities for

- Recognizing change requirements,
- Assessment of system vulnerability,
- Selection and implementation of changes, and
- Documentation and distribution of changes.

Modern communications links do not exist to support management and engineering, to increase productivity and mission responsiveness, and to offset training and travel costs.

INITIATIVE
ECS SUPPORT
NETWORKS
SUPPORT FACILITIES

◆ **FUTURE ECS SUPPORT POSTURE BENEFITS**

Local and command-wide communications links with capabilities for voice data and video which support

- ECS change process,
- Large accessible data base,
- Automated standardized tools,
- Intelligence handling,
- Rapid reprogramming,
- Software repository,
- Modular ISF, and
- Training and education.

3. IMPLEMENTATION APPROACH

Aggressive staff action is the recommended approach for implementation of the majority of the administrative initiatives. However, the programmatic initiatives involve significant resources and their implementation will probably require use of the well-established Department of Defense and Air Force acquisition process. The overall implementation approach for the initiatives is shown in Figure 7. The six-step process for system acquisition served as a model for development of implementation detail for the four programmatic initiatives. In Volume II, an individual task sheet is provided for each step. In addition, the process is supplemented for each programmatic initiative, with a pictorial of the conceptual evolution of the capability associated with the particular initiative, followed by a summary task sheet which aggregates the details contained in the individual phase task sheets. Also provided with each individual phase or activity task sheet is a flow chart with inputs from or interfaces with other initiatives. In those cases which require more than the six steps shown in the model, additional task sheets are provided. A complete complement of summary and detailed task sheets in the following format is included for each programmatic initiative in Volume II, Section 5.

- **Task Objective(s):** Describes key elements of the initiative and overall objectives to be achieved.
- **Major Issues/Problem Areas:** Identifies major issues or problem areas associated with implementation of the initiative.
- **Task Approach:** Describes overall approach and sequential activities for achieving the objective.
- **Level of Effort:** Estimates management and technical person years required to accomplish implementation activities.
- **Performer Experience Level/Background:** Identifies primary disciplines involved and necessary experience level and background required to accomplish the task.
- **Task Inputs/Interfaces:** Specifies dependencies affecting the initiative and their impacts on other initiatives.
- **Task Deliverables/Key Milestones:** Provides overall schedule for implementing initiatives and identifies key events and milestones in acquisition process.

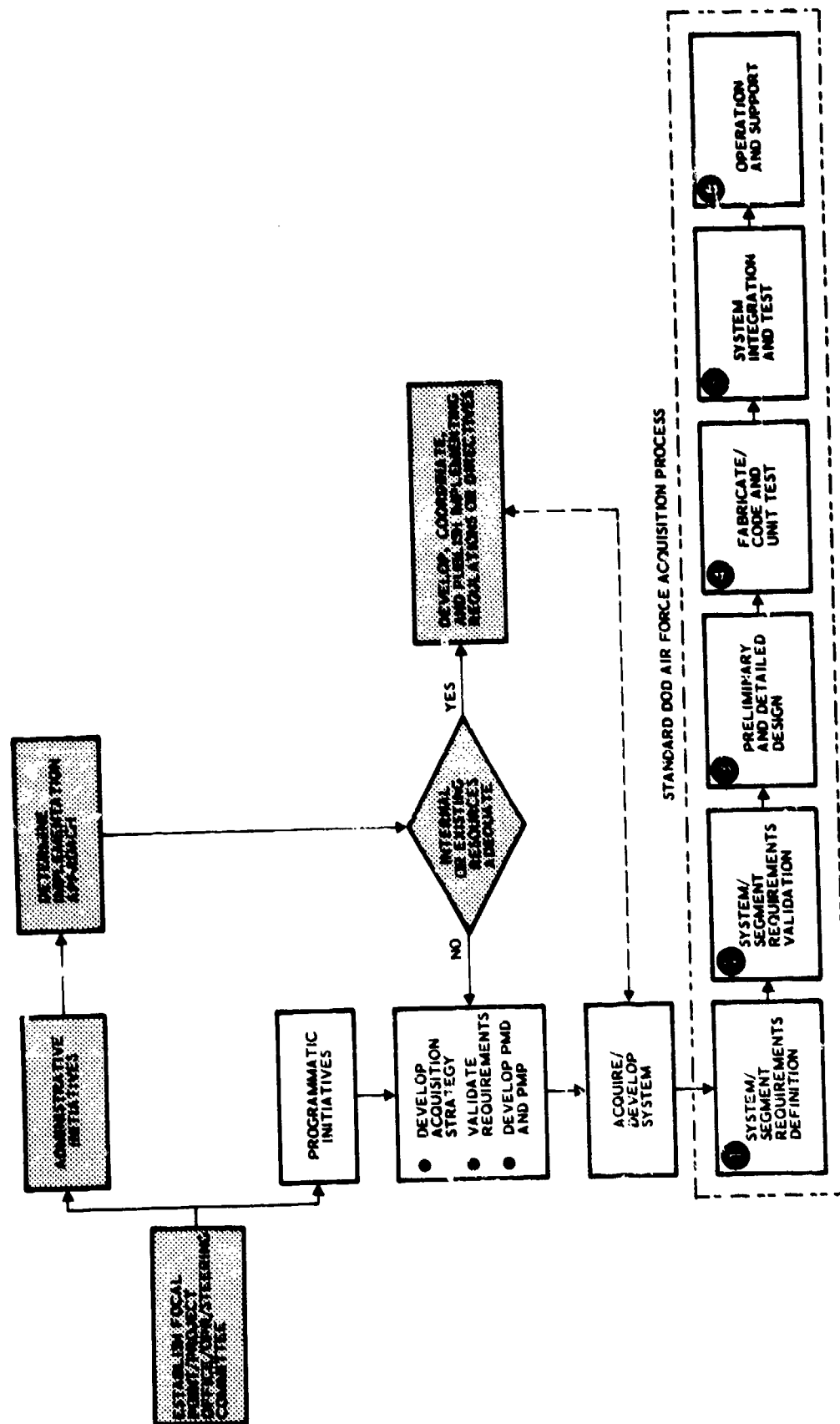


Figure 7. Long Range Plan for Support of ECS: Implementation Approach

4. SUMMARY

Concurrent implementation of the administrative initiatives combined with the four programmatic initiatives is recommended to address ECS life cycle support. Early implementation of the administrative initiatives is needed not only to correct deficiencies in the acquisition and operation of ECS support systems in the near term, but to establish a clear framework of policy and guidance for AFLC interactions and coordination with the development and user commands; early implementation is also required to enable the subsequent actions necessary for enhancing existing capabilities and acquiring new capabilities to improve the ECS support process through implementation of the programmatic initiatives. The recommendations for each initiative related to the ECS support process, with anticipated benefits, estimated resources, and the development period required for improving the overall future ECS support posture, are summarized in Figure 8.

The programmatic initiatives and appropriate references to the Phase II report and the Long Range Plan are shown below. Table 4 highlights the key features of the programmatic initiatives, summarizes the associated development period and resources to achieve an initial operational capability, and provides a quick reference to supporting data in the Long Range Plan.

- Automation and Standardization of ECS Support Processes: Phase II Final Report identified deficiencies associated with current ECS support posture. Volume II of the Long Range Plan provides rationale in Section 4.1 and implementation detail for acquiring tools for automation and standardization of ECS support processes in Section 5.2.1.
- Modular Extendable Integration Support Facilities: Volumes VI-VII, Phase II Final Report, discuss deficiencies in ECS support posture for each of the five ECS categories. Volume II, Section 4.2 of the Long Range Plan describes elements and merits of modular extendable integration support facilities. Implementation detail is provided in Section 5.2.2.
- ECS Readiness Support: Phase II Final Report Volume II and classified section at HQ AFLC identifies this requirement. This initiative which affects ATD, C-E, EW, and OFP ECS categories is further discussed in Volume II, Section 4.3 of the Long Range Plan with implementation detail provided in Section 5.2.3.
- ECS Support Networks: Volume II, Section 4.2.2.4 (Local Networks) and Section 4.4 (Command-Wide Networks) discusses rationale for networking as a high-leverage initiative for supporting all other initiatives in facilitating increases in productivity and mission responsiveness. Implementation detail is provided in Section 5.2.4 of the Long Range Plan.

LONG-RANGE PLAN

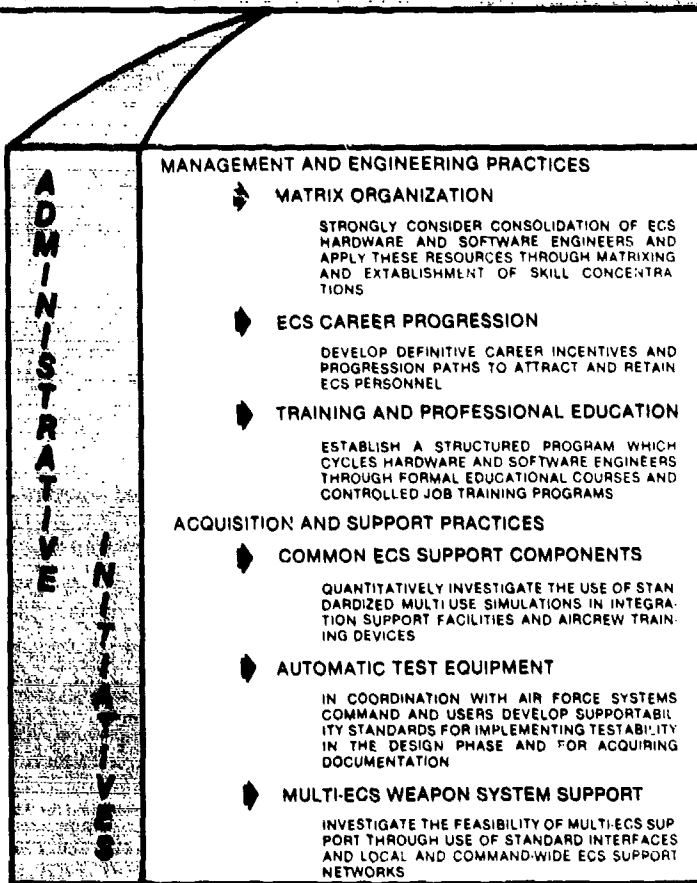
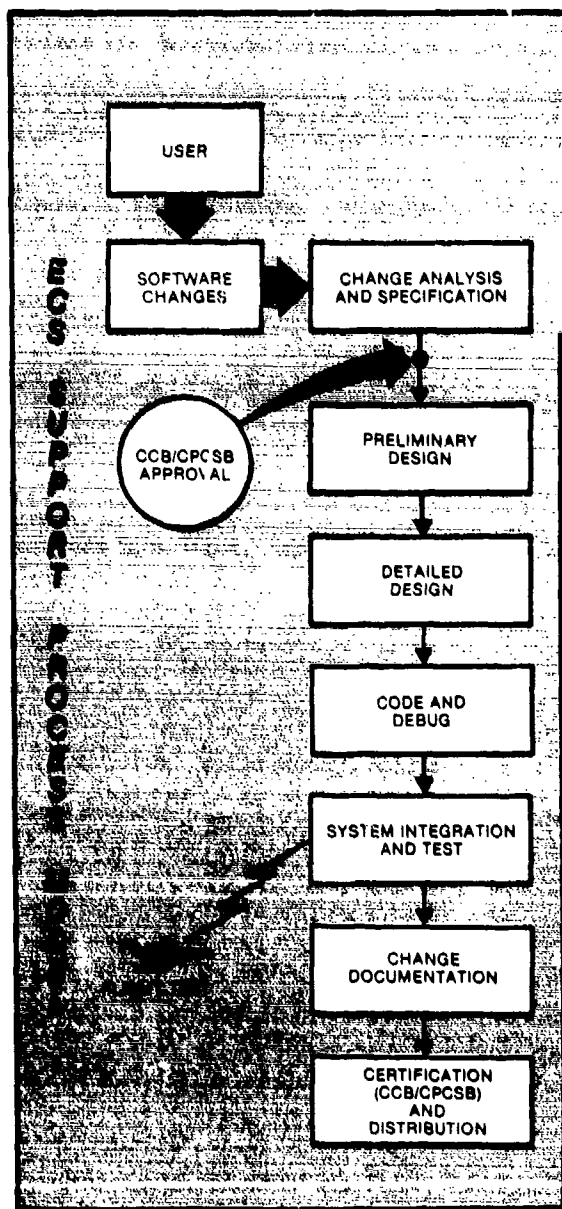
1981

INCREASED PR

CURRENT ECS SUPPORT POSTURE

CURRENT ECS SUPPORT PROCESSES ARE PERSON POWER INTENSIVE, AND IN THE AGGREGATE USE A PROLIFERATION OF NON-STANDARD SUPPORT TOOLS, PROCEDURES AND NOMENCLATURES WHICH ARE COSTLY AND DECREASE PRODUCTIVITY

CAPABILITY IS LIMITED OR NON-EXISTENT TO RESPOND TO ADVERSARY THREATS TO C-E, EW, AND OFP (FIRE CONTROL RADARS) WHICH AFFECT MISSION RESPONSIVENESS



ADMINISTRATIVE INITIATIVES

NEAR-TERM BENEFITS

PROGRAMMATIC INITIATIVES

CREASED PRODUCTIVITY AND MISSION RESPONSIVENESS

1990

BENEFITS

PERSON
USE A
SUPPORT
WHICH

ECS SUPPORT FACILITIES ARE SYSTEM UNIQUE WITH
A PROLIFERATION OF HARDWARE AND SOFTWARE
FOR ACCOMPLISHING COMMON FUNCTIONS WHICH
INCREASES COSTS AND REDUCES PRODUCTIVITY

MODERN COMMUNICATIONS LINKS DO NOT EXIST TO
SUPPORT MANAGEMENT AND ENGINEERING,
INCREASE PRODUCTIVITY AND MISSION RESPONSIVE-
NESS, AND OFFSET TRAINING AND TRAVEL COSTS

PROGRAMMATIC INITIATIVES

♦ AUTOMATION AND STANDARDIZATION OF ECS SUPPORT PROCESSES

ESTABLISH AND ARTICULATE POLICY AND
GUIDANCE FOR CONDUCTING THE ECS SUPPORT
PROCESS AND ACQUIRE AUTOMATED AND STAN-
DARDIZED TOOLS FOR ACCOMPLISHING THE
PROCESS

♦ MODULAR EXTENDABLE INTEGRATION SUPPORT FACILITIES

ESTABLISH STANDARD MODULES, INTERFACES,
INTERFACE UNITS AND ARCHITECTURES, AND
EXPAND AND EXTEND INTEGRATION SUPPORT
CAPABILITIES TO MULTIPLE SYSTEMS AND MULTI-
PLE FUNCTIONS

♦ ECS READINESS SUPPORT

ESTABLISH INTELLIGENCE AND DATA HANDLING
CAPABILITIES AND ENHANCE OR ESTABLISH SUP-
PORT CAPABILITIES FOR PREEMPTIVE ENGINEER-
ING TO RESPOND TO ELECTRONIC THREATS

♦ ECS SUPPORT NETWORKS

ESTABLISH COMMUNICATIONS LINKS WITH
CAPABILITIES FOR VOICE, DATA AND VIDEO
TRANSMISSIONS TO SUPPORT LOCAL AND MULTI-
PLE SYSTEM INTEGRATION SUPPORT FACILITIES,
AND TO SUPPORT COMMAND-WIDE MANAGEMENT
AND ENGINEERING

♦ AUTOMATED STANDARDIZED ECS SUPPORT TOOLS FOR

- MANAGEMENT
- DOCUMENTATION
- ANALYSIS
- SPECIFICATION
- SOFTWARE DEVELOPMENT
- TEST
- LOCAL DEVELOPMENT PROJECTS

♦ 14 PERSON YEARS
♦ 4.5 YEARS

♦ BUILDS UPON EXISTING INVESTMENT IN ECS SUPPORT FACILITIES TO SUPPORT

- COMBAT MISSION READINESS
- WEAPON SYSTEM GROWTH AND PLANNED
PRODUCT IMPROVEMENTS
- MULTIPLE SYSTEMS WITH SINGLE ISF
- SYSTEMS WITH DISSIMILAR ARCHITEC-
TURES, LANGUAGES, AND INPUT/OUTPUT
REQUIREMENTS
- MULTIPLE FUNCTIONS WITH COMMON
MODULES
- AUTOMATED STANDARD-
IZED TOOLS
- TRAINING

♦ 61 PERSON YEARS
♦ 6 YEARS

♦ ECS READINESS SUPPORT CAPABILITIES FOR

- RECOGNIZING CHANGE
REQUIREMENTS
- ASSESSMENT OF SYSTEM
VULNERABILITY
- SELECTION AND IMPL-
MENTATION OF CHANGES
- DOCUMENTATION AND
DISTRIBUTION OF CHANGES

♦ 75 PERSON YEARS
♦ 4 YEARS

♦ LOCAL AND COMMAND-WIDE COMMUNI- CATIONS LINKS WITH CAPABILITIES FOR VOICE, DATA, AND VIDEO WHICH SUPPORTS

- ECS CHANGE PROCESS
- LARGE ACCESSIBLE DATA BASE
- AUTOMATED STANDARDIZED TOOLS
- INTELLIGENCE HANDLING
- RAPID REPROGRAMMING
- SOFTWARE REPOSITORY
- MODULAR ISF
- TRAINING AND EDUCATION

♦ 212 PERSON YEARS
♦ 8 YEARS

MID- TO LONG-TERM BENEFITS

Figure 8. Initiatives for Improving
ECS Support Posture

Table 4. Programmatic Initiatives: Summary

KEY FEATURES	INITIAL OPERATIONAL CAPABILITY, YR	RESOURCES, PERSON YR	VOL. II SUPPORTING DATA, SECTION	
			RATIONALE	IMPLEMENTATION
<ul style="list-style-type: none"> ● AUTOMATION AND STANDARDIZATION OF ECS SUPPORT PROCESSES <ul style="list-style-type: none"> • SOFTWARE DOCUMENTATION SYSTEM • CONFIGURATION MANAGEMENT SYSTEM • DATA BASE MANAGEMENT SYSTEM • MANAGEMENT INFORMATION SYSTEM • SOFTWARE REPOSITORY • IMPROVED ANALYSIS TOOLS • COMPREHENSIVE DEVELOPMENT, MAINTENANCE, AND TEST TOOLS 	4.5	14	4.1	5.2.1
<ul style="list-style-type: none"> ● MODULAR EXTENDABLE INTEGRATION SUPPORT FACILITIES <ul style="list-style-type: none"> • COMPACT COMPUTING WORK STATION MODULES • HARDWARE SIMULATION KERNELS • REPROGRAMMABLE COMPUTER MONITOR AND CONTROL UNIT • PROGRAMMABLE INTERFACE UNIT 	6	64	4.2	5.2.2
<ul style="list-style-type: none"> ● ECS READINESS SUPPORT <ul style="list-style-type: none"> • INTELLIGENCE AND OPERATIONAL INPUTS FOR RECOGNIZING CHANGE REQUIREMENTS • PROCEDURES FOR ASSESSMENT OF THE SITUATION • CAPABILITIES FOR SELECTING AND IMPLEMENTATION OF CHANGES • DOCUMENTATION AND DISTRIBUTION OF CHANGES 	4	75	4.3	5.2.3
<ul style="list-style-type: none"> ● ECS SUPPORT NETWORKS <ul style="list-style-type: none"> • COMMAND-WIDE ECS SUPPORT NETWORK • LOCAL ECS SUPPORT NETWORKS • DATA BASE MACHINE 	6	212	4.2.2.4, 4.4	5.2.4